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1 Most Suitable Area Available for Field Trials On Salisbury Plain.

2 Values of Estimated Means and Standard Deviations For Parameters Varied Stochasticaly in the Bristol RCI model.

1. Objectives and Scope

The prediction of environmental factors such as soil moisture, soil strength etc., at a reasonably coarse scale (e.g. 0.2 - 25 km) with limited input data is the prime objective of this research project. This is a first attempt to be made at this scale, as previous models have tended to concentrate at the hillslope or very large scales. The main objectives have been detailed in the Third and Fifth Interim Reports (Contract No. DAJA45-85-0007).

In this report the objectives have been further refined as follows:

(a) to continue development of a physically based scheme for forecasting various environmental factors such as soil moisture and soil strength,

(b) to set up appropriate field trials as a method of verification and validation of our scheme,

(c) to further develop the operational aspects of the scheme with respect to ground rules for setting up the scheme.

The scope of this report is:

(i) to discuss the setting up of field trials,

(ii) to detail the inclusion of stochastic variation of several environmental parameters within the model,

(iii) to detail preliminary ground rules for application of the scheme to large areas.

Keywords: mathematical models, soil dynamics, soil mechanics

2. Field Trials

Ministry of Defence, RARDE section, identified several areas within Salisbury Plain Training Area (SPTA) that would possibly be suitable for soil moisture/strength predictions and measurements, and the effects these have on tracked mobility predictions. The mobility predictions are to be validated with actual vehicle runs.

From the options available it was decided that a section of SPTA 9 was most suitable (figure 1). The area is just north of the A344 in grid square 0143. It contains a valley with one slope facing northwesterly and the other southeasterly. There are areas of essentially flat ground at each side of the valley. The vegetation is pasture which is occassionally grazed by cattle. The ground showeda reasonable homogenous layer of soil about 100mm to 500mm deep over a hard layer of chalk and flint. The soil showed a tendency to poaching where cattle had trampled often during wet periods.

It was decided that a topographic survey was necessary as previous ordinance suveys did not map the area down to the scale required. The results (figure 2) from this are to be used in route planning and soil sample survey design.

3. Stochastic Variation Of Model Parameters

The model has been upgraded to include the inherent variability of several of the environmental parameters used. This has been incorporated througt the use of the Numerical Algorithms Group Ltd. FORTRAN Library (NAG subroutines). An example of distributions (Hillel,1980) used is given in figure 3 for six soil parameters.

4. Preliminary Ground Rules For Large Areas

The versatility of the scheme in terms of spatial resolution has resulted in defining ground rules for setting up the scheme at different scales.

An area to the northeast of Bath was considered and subsequently the following ground rules were formulated to aid setting up the scheme for large areas:

1. Id of major soil types (1-11)
2. Id of no-go areas
3. Id of major 'a/s' areas, where a = area drained per unit contour length and s = local slope angle. (number of a/s categories = AS)
4. Id major soil area as % of 'go' area (MAX)
5. Enter equation 1.1 with results from 3&4 to determine minimum area (MIN) for differentiation
6. Id all soil areas as defined in 5
7. Total number of soil areas x AS = maximum possible number of runs
8. Compare value calculated in 7 with computer restricted run number - adjust MIN until within acceptable restricted run number
9. Id each grid square with 'run number'
10. Set up on the computer:
    (a) input files for all possible runs (menu driven)
    (b) grid description (menu driven)
11. Run package (menu driven)

Equation 1.1

1st approximation to minimum soil area to consider

$$MIN = \frac{AS(100-MAX)}{(R-AS)}$$

where MIN = % minimum soil area to be considered

MAX = % maximum area of major soil type

AS = number of a/s categories

R = maximum number of computer runs available

5. Conclusions

Development of the physically based scheme and the preliminary ground rules are now at a stage where initial verification and validation are necessary to refine both model and ground rules. To fulfil this, a topographic survey of a carefully choosen site on Salisbury Plain has been carried out and arrangements are being made to hold field trials with a tracked vehicle. Prediction of speeds is to made by the MOD's DRIVEB computer model. 'DRIVEB' requires soilstrength (RCI) as one of its input parameters, and it is hoped that estimates from both the SMSP and the Bristol models will be used in a series of applications.

6. Future Development

(i) Prepare and set up trials on Salisbury Plain,

(ii) develop a route evaluation/prediction scheme,

(iii) develop menu driven input and operation for all Bristol schemes,

(iv) design trial storms for SMSP and Bristol model generated RCI input to DRIVEB.

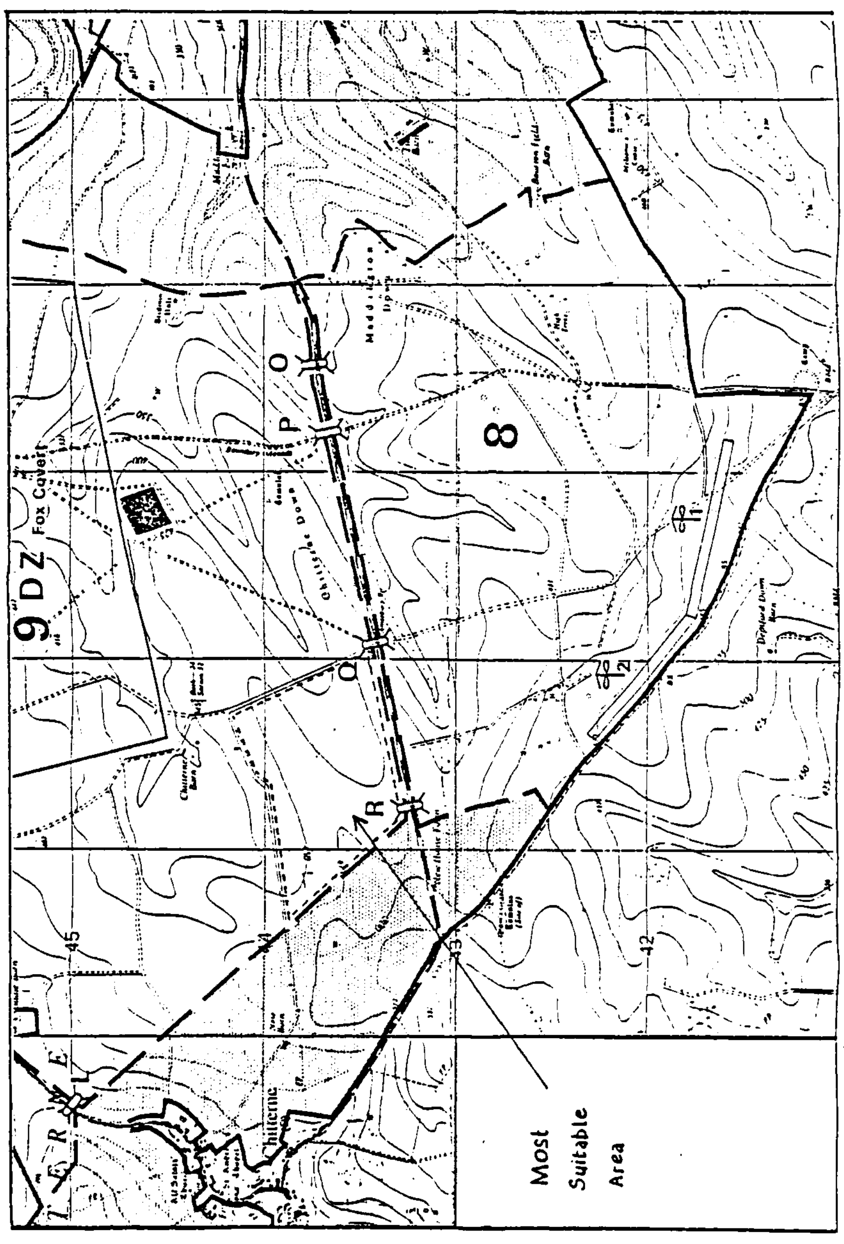
9 DZ
Fox Cover
8
O
P
Q
R
Chilterne
Most Suitable Area
Chitterne Down
Maddington Down
45
44
43
42
00
01
02
03
04
05

FIGURE 1

Figure 2: Results from Topographic Survey of Area defined in Figure 1.

FIGURE 2 : Values Of Estimated Means And Standard Deviations For Parameters Varied Stochasticaly In The Bristol RCI Model. (after Hillel 1980)

Parameter	Mean	S.D.	Reference
k_{sat}	14cm/hr	26	Gumaa
	20cm/hr	22	Nielsen et al.
	35cm/hr	30	Nielsen et al.
θ_{sat}	0.40	0.045	Nielsen et al.
	0.45	0.048	Nielsen et al.
	0.47	0.048	Cameron
bulk density	1.3	0.09	Gumaa
	1.4	0.095	Nielsen et al.
	1.5	0.11	Cassel et al.
sand %	53	15	Gumaa
	59	22	Gumaa
	26	11	Nielsen et al.
	24	14	Nielsen et al.
silt %	28	9.1	Gumaa
	27	6	Nielsen et al.
	30	8	Nielsen et al.
clay %	47	6	Nielsen et al.
	19	6.8	Gumaa
	12	6.4	Gumaa

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